A NEW SPECIES OF *OSMUNDACAULIS* FROM THE JURASSIC OF QUEENSLAND

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(Communicated by J. F. Rigby)

(Plates III-V)

[Accepted for publication 21st February 1973]

Synopsis

A new species of petrified osmundaceous stem, *Osmundacaulis hoskingii* sp. nov., is described from the Jurassic Injune Creek Beds of the Surat Basin, Queensland. Distinguishing features include : a dissected siphonostele with internal and external endodermis, leaf gap sclerenchyma, and numerous, deep, narrow xylem strands ; the petiole bases exhibit a crenate mass of sclerenchyma lining the adaxial bay of the vascular trace and numerous scattered sclerenchyma strands in the inner cortex and stipules. These stems represent the earliest known appearance of the " *O. skidegatensis* group ". The species contains two varieties, *O. hoskingii* var. *hoskingii* and *O. hoskingii* var. *tabulatus* var. nov. ; the latter is characterized by the presence of unusual tabulae-like structures in the pith.

Introduction

Jurassic strata in Queensland have yielded numerous specimens of fossil osmundaceous stems, and some of these have been reported by Kidston and Gwynne-Vaughan (1914), Dunstan (1920), Sahni (1920), Edwards (1933), and Hill, Playford, and Woods (1966). Almost all have been referred to the species *Osmundacaulis dunlopi* (Kidston and Gwynne-Vaughan) Miller 1967 or *O. gibbiana* (Kidston and Gwynne-Vaughan) Miller 1967, which were originally described from the Jurassic of New Zealand (Kidston and Gwynne-Vaughan, 1907). The new species described here, *O. hoskingii* sp. nov., is based on several silicified specimens collected from the Injune Creek Beds on " Mt. Organ " Station in the Surat Basin west of Wandoan (Text-fig. 1), and is divided into two varieties, *O. hoskingii* var. *hoskingii* and *O. hoskingii* var. *tabulatus* var. nov. The Injune Creek Beds are of Middle Jurassic age, although they possibly extend into the Upper Jurassic ; the stratigraphy has been discussed elsewhere (Gould, 1968). Specimens are housed in the Department of Geology and Mineralogy, University of Queensland (UQ).

Systematic Palaeobotany

Division PTEROPHYTA

Order FILICALES

Family OSMUNDACEAE

Genus Osmundacaulis Miller, 1967

Type species : Osmundites skidegatensis Penhallow, 1902 (Miller, 1967).

Original diagnosis : Structurally preserved rhizomes, roots, and (or) leaf bases of plants resembling species of *Leptopteris*, *Osmunda*, or *Todea*, but which cannot be assigned to any one of these genera. Stems containing a pith ; xylem cylinder dissected by leaf gaps ; leaf traces oblong or adaxially curved in transverse section ; xylem strand of root diarch (Miller, 1967, p. 146).

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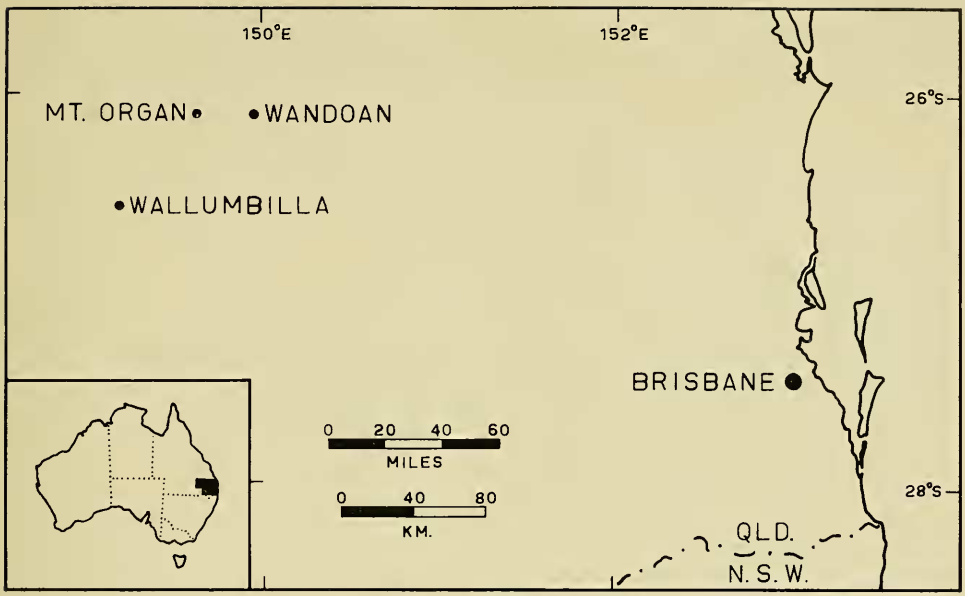


Text-fig. 1. Locality map.

Discussion: The organ genus *Osmundacaulis* was instituted for fossil axes which exhibit the general features of trunks and rhizomes of living Osmundaceae, but cannot be classified in any extant genus " for one or more of the following reasons :

(1) Lack of preservation of sufficient diagnostic detail,
(2) the presence of structural features that are not characteristic of living species, and
(3) the combination of features of Recent genera in such a way that assignment to one of them cannot be made " (Miller, 1967).

Osmundites Unger, 1854, was illegitimate because of Jaeger's (1827) prior use of the name for misidentified cycadophyte foliage ; in any case Unger's type species, *Asterochlaena schemnicensis* Pettko, 1849, actually belongs to *Osmunda* (Miller, 1967). A very complete survey of the fossil Osmundaceae has recently been presented by Miller (1971).

Living osmundaceous genera have been distinguished on morphology of sterile and fertile fronds ; recognition of species has also depended on various aspects of frond morphology (Hewitson, 1962). However, it has been found that genera can be recognized on anatomical details of the stem and stele, and the arrangement of sclerenchyma in the petiole bases (Hewitson, 1962 ; Miller, 1967, 1971). The structure and disposition of sclerenchyma in the petioles is the only character which is reliable for purposes of species recognition (Kidston and Gwynne-Vaughan, 1907 ; Hewitson, 1962 ; Miller, 1967, 1971), and thus studies of fossil axes can be undertaken with some confidence.

In the following descriptions the number of gaps appearing in a transverse section of the xylem cylinder is given, and this is equal to the number of " bundles " as defined by Hewitson (1962, p. 80). The term " radial strand " is used here for any group of stelar xylem tracheids with a prominent radial dimension when seen in transverse section, regardless of whether the group is connected to adjacent strands or not. By investigation of extant examples, Miller (1971) has shown that the rhizomatous or arborescent habit of the stem is reflected by the direction of growth of the roots, and hence the growth habit of

fossil axes can be determined. In rhizomatous specimens the roots permeate outwards through the mantle of leaf bases and most are cut longitudinally by a transverse section of the axis ; in arborescent forms the roots grow down through the mantle and most are cut transversely by a cross-section of the trunk.

Osmundacaulis hoskingii sp. nov.
(Plate III, Figs 1, 2 ; Plate IV, Figs 1–8 ; Plate V, Figs 1–6 ; Text-figs 2A–D, 3A–I)

Holotype: UQF53534 ; figured in Plate III, Fig. 2 ; Plate IV, Fig. 2 ; Text-fig. 2A.

Type locality: " Mt. Organ " Station, via Wandoan, Queensland (Roma 4-mile Military Sheet c. 250756) ; Injune Creek Beds.

Diagnosis: Arborescent and rhizomatous axes of *Osmundacaulis* with stems 8–30 mm wide, surrounded by adhering leaf bases and adventitious roots. Stele a dissected siphonostele, 6–20 mm in diameter ; endodermis internal and external, connected through leaf gaps, with 2–10 such gaps in a transverse section ; pith of parenchyma with scattered strands of sclerenchyma ; xylem ring 1–5 mm wide, composed of 35–70 radial strands, with 14–20 gaps ; each radial metaxylem strand 20–64 tracheids deep with tangential width of 2–12 tracheids ; metaxylem tracheids 14–110μ in diameter (rarely up to 150μ) with 1–3 vertical series of regular scalariform pits on each wall ; leaf gaps immediate, usually containing sclerenchyma. Inner cortex parenchymatous, sometimes with scattered strands of sclerenchyma ; outer cortex sclerenchymatous. Leaf trace with two endarch protoxylem groups which bifurcate at base of petiole or higher ; adaxial ends of C-shaped trace strongly incurved and commonly merged together in outer cortex of stem and basal part of petiole ; sclerenchyma from leaf gap may be continuous along trace, or develop within adaxial bay of trace in outer cortex of stem and in base of petiole. Petioles stipulate, arising at 5°–30° to stem ; cataphylls occasionally present ; single mass of sclerenchyma lining adaxial concavity of C-shaped petiolar strand, upwards appearing crenate in transverse section ; inner cortex parenchymatous, usually with scattered strands of sclerenchyma ; sclerotic ring round or oval, homogeneous ; stipules parenchymatous with scattered sclerenchyma strands increasing in number and size upwards. Adventitious root traces arise in pairs from leaf trace below, or where, latter separates from stele ; each root trace surrounded by a parenchymatous inner and sclerotic outer cortex where it enters inner cortex of stem.

Derivation of name: The plant is named after Mr. and Mrs. I. Hosking and sons (" Mt. Organ " Station, via Wandoan), who collected, and kindly presented to the author, many of the specimens used in this study.

Discussion: *Osmundacaulis hoskingii* is characterized by a dissected siphonostele with leaf gap sclerenchyma and deep, narrow, xylem strands ; the fusion of the incurved ends of the leaf trace in the stem and basal part of petiole ; and the distribution of sclerenchyma in the petioles (Text-fig. 2B, D). The species conforms with Miller's (1967, 1971) " *O. skidegatensis* group ", and represents the earliest appearance of this type in the fossil record.

The new species contains two distinct varieties, the type variety *O. hoskingii* var. *hoskingii*, and *O. hoskingii* var. *tabulatus* ; these are described and discussed in the following pages.

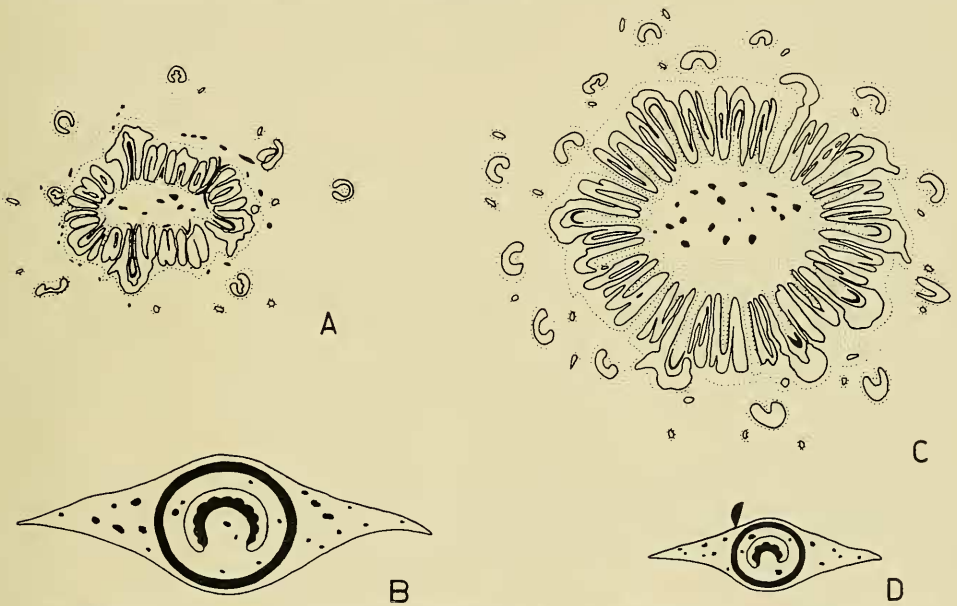
Osmundacaulis hoskingii sp. nov. var. *hoskingii*
(Plate III, Figs 1, 2 ; Plate IV, Figs 1–8 ; Plate V, Fig. 1; Text-figs. 2A, B, 3A–I)

Varietal type: UQF53534 (holotype of species).

Diagnosis: *Osmundacaulis hoskingii* axes up to 20 cm in diameter ; stems 8–20 mm wide, usually arborescent. Stele about 6–12 mm in diameter ; internal and external endodermis connected through 2–10 complete leaf gaps in a trans-

verse section ; pith 4–9 mm by 1–5 mm, parenchymatous, with scattered strands of sclerenchyma ; xylem ring 1–3 mm wide, composed of 35–48 radial strands with 14–20 gaps, each strand 20–56 tracheids thick with tangential width of 2–12 tracheids. Inner cortex 0·3–3 mm wide, parenchymatous, sometimes with scattered sclerenchyma strands, containing 3–13 leaf traces in any one given transverse section. Outer cortex fibrous, narrow, sinuous, 0·1–1·7 mm wide, containing 3–7 leaf traces in a transverse section. Petioles arise at 5°–15° to stem ; cataphylls occasionally present ; at outside of mantle petiole bases show crenate mass of sclerenchyma lining adaxial bay of vascular trace and numerous scattered sclerenchyma strands in inner cortex and stipules.

Further description and discussion : General.—The variety is described from six specimens which are round or slightly oval in cross-section, with lengths of up to 13 cm although both ends are broken across. Each specimen contains a central stem composed of a pith, vascular ring, inner cortex, and a narrow sclerotic outer cortex ; this is surrounded by a closely adhering mantle of petiole bases and adventitious roots (Plate III, Figs 1, 2).



Text-fig. 2. All ×3·4. A, B, *Osmundacaulis hoskingii* sp. nov. var. *hoskingii*. A, cross-section of stele, UQF53534 (holotype) ; B, transverse section of petiole. C, D, *Osmundacaulis hoskingii* sp. nov. var. *tabulatus* var. nov. ; C, transverse section of stele, UQF53539 (varietal type) ; D, transverse section of petiole. Sclerenchyma black ; in cross-sections of steles endodermis shown by a dotted line, sclerenchyma of outer cortex not shown.

Stele.—A cross-section of the stele is shown in Text-fig. 2A. Endodermal tissue consists of one layer of cells with well-developed Casparian strips ; in longitudinal section the walls are finely waved (*cf.* Esau, 1953, fig. 17.2C). Protoxylem tracheids are 10–20μ in diameter with walls 1–6μ thick ; metaxylem tracheids have diameters of 14–96μ (rarely up to 150μ) and wall thicknesses of 2·5–14μ. Details of cells between the xylem and the endodermis are mostly not preserved. A porose layer of phloem is developed on the abaxial side of the xylem ring, and thin-walled, somewhat disorganized cells occur between the internal endodermis and the adaxial ends of the radial metaxylem strands.

Leaf traces.—The xylem of the leaf trace usually separates from the stem xylem with two endarch protoxylem groups ; in a few cases there are one or

three groups (Plate IV, Fig. 8). However, unlike the condition in *Plenasium* Presl, 1836, where the leaf trace also exhibits two proximal protoxylem groups and separates from two adjacent crozier-shaped metaxylem strands (see Hewitson, 1962; Chandler, 1965; Miller, 1967, 1971), each trace in *O. hoskingii* var. *hoskingii* is associated with only one original metaxylem strand of the stem which is divided into two strands by the leaf gap. Text-figure 3 shows the sequence as would be seen in an ascending series of transverse sections; some details are also shown in Plate IV, Figs 5–8. The leaf trace is strongly arched within the stem and extreme base of the petiole, and the incurved ends of the trace commonly fuse together, showing in section a circle of endodermis, with the accompanying sclerenchyma and inner cortex, within the oval trace (Plate IV, Fig. 1). The trace opens out again into the normal C-shape in the petiole. Total number of leaf traces in a transverse section of the whole cortex of the stem is 7–19.

Petioles.—The leaf bases consist of a vascular trace, inner cortex, sclerotic ring, and a pair of lateral stipules (Plate IV, Fig. 4; Text-fig. 2B); except for the stipules, which arise with the petiole, the tissues are continuous with the corresponding zones of the stem. The bases range from 2·5–4 mm wide, tip to tip, where they leave the stem, to 15–34 mm wide at the outside of the mantle. Cataphylls appear to be present in two specimens, but they are not regularly arranged.

The xylem of the petiolar trace contains metaxylem tracheids that are 23–95μ (occasionally up to 140μ) in diameter; the xylem trace is 1–6 (mostly 1–4) tracheids thick. Two or three protoxylem groups project on the adaxial side of the trace at the very base of the petiole, and 6–21 groups occur at the outside of the mantle. In some cases, although the vascular trace retains its adaxially curved C-shape, the xylem may be divided into two or three strands.

The xylem trace is usually surrounded by a parenchymatous sheath, phloem, pericycle, and endodermis. In some cases there is a greater development of phloem on the abaxial side of the trace, and in a few petioles of one specimen there is an abnormal development of pericycle with large cells up to 140μ by 70μ. The endodermis is one or two cells thick, often dark in colour, and shows distinct Casparian strips.

The concavity of the C-shaped vascular trace is lined with a single mass of sclerenchyma; this exhibits a distinctly crenate appearance in transverse section as the abaxial side closely parallels the adaxial side of the xylem trace, and the sclerotic mass is indented opposite the projecting protoxylem groups (Plate IV, Fig. 2). Walls of the fibres nearest the endodermis usually have reticulate thickening.

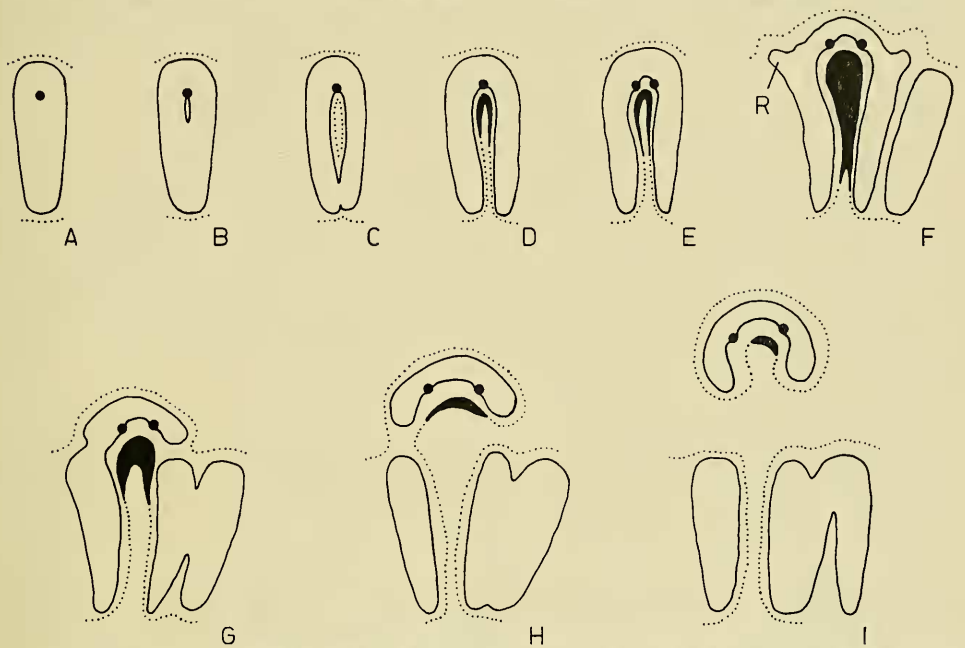
The inner cortex of the petiole base consists of polygonal parenchyma cells, generally with scattered strands of sclerenchyma fibres which increase in number upwards. Sometimes the strands occur throughout the tissue right from the inner cortex of the stem, while in other cases the strands are not developed, the inner cortex being parenchymatous throughout.

The sclerotic rings are round to oval in cross-section, measuring 1·5–2·3 mm in diameter near the stem and 3–11 mm at the outside of the mantle; thickness of the ring varies from 0·13–0·5 mm near the point of attachment to the stem to 0·2–0·6 mm further out. There is a slight increase in fibre diameter from the outside to the inside of the ring, which is otherwise homogeneous.

The stipules consist of polygonal parenchyma cells with strands of sclerenchyma. Some radially elongated parenchyma cells, arranged perpendicularly to the surface of the petiole, may occur on the abaxial side of the sclerotic ring. One or two sclerenchyma strands are usually present in the base of the stipules, and these increase to over 30 at the periphery of the mantle; sometimes, however, the stipules are parenchymatous where they arise from the stem, and the sclerenchyma strands develop higher up.

Roots.—The adventitious roots are 0·5–2·5 mm in diameter. Within the mantle the majority are cut transversely by a transverse section of the axis, indicating that the plant was probably arborescent; in a cross-section of one specimen, however, the roots are seen in longitudinal section.

Foreign intrusions.—Some of the specimens contain foreign axes consisting of a star-shaped xylem trace and a parenchymatous cortex; these axes commonly displace the parenchymatous tissue of the pith and inner cortex of the stem and petioles (*e.g.* Plate IV, Fig. 3). A somewhat similar axis has displaced the stem in the holotype of *O. kidstoni* (Stopes) Miller, 1967, which is from probably Lower Cretaceous strata near Wallumbilla (Stopes, 1921; Posthumus, 1924).



Text-fig. 3. A–I, stylized series of ascending transverse sections showing separation of leaf trace from a strand of stelar xylem and formation of leaf gap in *Osmundacaulis hoskingii* sp. nov. var. *hoskingii*. Internal endodermis commonly does not appear within xylem strand as shown in C; development of leaf gap sclerenchyma also varies. Sclerenchyma black; endodermis dotted line; protoxylem large black dots; R, root trace.

Comparison.—The new variety can be closely compared with two rather ill-preserved forms described by Schelpe (1955, 1956) from the Lower Cretaceous (Neocomian) Uitenhage Series of South Africa, *O. natalensis* (Schelpe) Miller, 1967, and *O. atherstonei* (Schelpe) Miller, 1967. *Osmundacaulis natalensis* is very similar to *O. hoskingii* var. *hoskingii* in many respects, including the stele and leaf traces (see Schelpe, 1955, pp. 653–654, fig. 1), but the petioles at the outside of the mantle only show a crenate mass of sclerenchyma within the adaxial bay of the vascular trace, with no sclerenchyma strands in the inner cortex or stipules (Schelpe, 1955, p. 655, fig. 4). Detailed comparison with *O. atherstonei* is not possible because of poor preservation.

Osmundacaulis hoskingii sp. nov. var. *tabulatus* var. nov.
(Plate V, Figs 2–6; Text-fig. 2C, D)

Varietal type: UQF53539; figured in Plate V, Figs 2–4; Text-fig. 2C.

Type locality: "Mt. Organ" Station, via Wandoan, Queensland; Injune Creek Beds.

Diagnosis: Rhizomatous axes of *O. hoskingii* with stems 18–30 mm wide. Stele 12–20 mm in diameter with 3–6 complete leaf gaps in a transverse section; pith 4–10 mm wide, interrupted by regularly spaced, broadly conical (height 2–3·5 mm), distally directed tabulae-like structures consisting of layers of thin-walled, rounded, polygonal, and irregular elongated cells; tabulate structures 0·7–1·5 mm thick, bounded by an endodermis usually connected to the internal endodermis of the stele; xylem ring 2·5–5 mm wide, composed of 53–70 radial strands, with 16–19 gaps, each strand 43–64 tracheids deep, and 2–11 tracheids wide tangentially. Inner cortex 1·5–3·2 mm wide, containing 12–20 leaf traces in a given transverse section. Sclerotic outer cortex irregular, 0·8–3 mm wide, containing 11–26 leaf traces in a transverse section. Petioles at the outside of mantle with crenate mass of sclerenchyma lining adaxial bay of vascular trace, and scattered strands of sclerenchyma throughout inner cortex and stipules.

Derivation of name: The varietal epithet derives from the presence of the tabulae-like structures in the pith.

Further description and discussion: General.—The variety is based on two incomplete specimens with radii of 3·5 cm and 3·8 cm, and lengths of 6 cm and 7 cm. Both specimens were probably rhizomatous. The type consists of a single central stem surrounded by a mantle of adhering leaf bases and adventitious roots (Plate v, Figs 2–4). The other specimen (UQF53540) contains three stems surrounded by a mantle (Plate v, Figs 5, 6); although, from their relative orientations, two of the stems would appear to arise from the third, their steles are not connected, those of the two subordinate stems being corroded where they touch the central one.

Stele.—The stele is similar to that in *O. hoskingii* var. *hoskingii*, although leaf gap sclerenchyma is not developed to such a marked extent (Text-fig. 2C). The pith consists of parenchyma and scattered strands of sclerenchyma, although the latter are not always present. The parenchyma cells are equidimensional, rounded to polygonal, and arranged more or less in vertical rows.

The pith is interrupted at intervals of 3–7·5 mm by transverse, broadly conical tabulae-like structures with the apices directed distally (Plate v, Figs 4, 6). The "tabulae" are 0·7–1·5 mm thick, and the vertical height of the cone from apex to base is 2–3·5 mm. The structures contain round, equidimensional polygonal, elongate, and irregular, thin-walled cells measuring 30–164μ in diameter, or 70–270μ by 18–140μ; when seen in a longitudinal section of the stem, the smaller, more equidimensional cells tend to be at the upper and lower surfaces of the cone, with the elongate, irregular and twisted cells confined to the median layer. The large, irregularly arranged cells are somewhat similar to some of the phloem on the abaxial side of the xylem ring. The "tabulae" are bounded by a line of endodermal cells, continuous with the internal endodermis of the stele. Cells of the pith adjacent to the "tabulae" are often larger than those of the rest of the pith, measuring 65–280μ by 55–95μ, with the long axes arranged perpendicularly to the "tabulae"; this tissue appears to be the result of meristematic activity. Some "tabulae" are incomplete in that the apex is lacking; also some may not be connected to the stele all round, thus appearing detached in a longitudinal section of the stem.

Protoxylem tracheids are 12–35μ in diameter with walls 1·5–7μ thick. Metaxylem tracheids are 27–140μ (mostly 40–110μ) in diameter; walls are 3·5–27μ thick. The xylem strands are surrounded on all sides by a parenchyma xylem sheath 3–16 cells thick. Phloem cells occur outside the xylem sheath on the abaxial side of the xylem cylinder, with their best development in the wedges between the external lobes of the xylem. A well-developed porose layer is present. Some of the cells are very similar to those in the median layer of the tabulae. Outside the phloem is a layer of crushed cells, possibly repre-

senting protophloem. The pericycle is normally 1–3 cells thick ; in some places, however, the xylem sheath and phloem are crushed and there is an abnormal development of large, linearly and radially arranged, pericycle cells, which is somewhat suggestive of meristematic activity.

The endodermis is 1–3 cells thick and Casparian strips are sometimes visible.

Leaf traces.—Leaf traces depart from the stele in the same manner as those in *O. hoskingii* var. *hoskingii*, and the incurved ends of the trace usually fuse together within the stem and proximal end of the petiole base. The leaf trace separates from the stele with two endarch protoxylem groups which bifurcate after the trace enters the petiole ; at the outside of the mantle there are 4–6 endarch protoxylem groups in the petiolar trace. Twenty-five to 44 leaf traces occur in any transverse section of the whole cortex of the stem.

Petioles.—The petiole bases are similar to those of *O. hoskingii* var. *hoskingii* although somewhat smaller (Text-fig. 2D), measuring 4–5 mm tip to tip where they arise, and 10–14 mm wide at the outside of the mantle. In specimen UQF53540 the leaf bases are disorganized and not well developed, but the structure is still discernible. Metaxylem tracheids of the petiolar trace are 40–96μ in diameter ; the xylem arch may break up into two or three segments as in *O. hoskingii* var. *hoskingii*. The xylem is surrounded by a xylem sheath, phloem, pericycle, and dark stained endodermal cells ; the phloem is mainly developed on the abaxial side of the trace. The round sclerotic rings are 1·7–2·5 mm in diameter near the stem and 1·2–5 mm further out ; thickness of the rings varies from 0·1 mm to 0·3 mm, and there is a slight increase in fibre diameter towards the inner cortex of the petiole.

Roots.—Diarch adventitious root traces arise in pairs from the stele in association with leaf traces. The roots are 0·5–1·5 mm in diameter, and they permeate through the mantle so that most are seen in longitudinal section in a transverse section of the axis. Roots are also found in the pith of the stem (Plate v, Figs 3, 4). In one of the specimens the roots form a mat outside the mantle of petiole bases.

Comparison.—The tabulate structures in the pith are characteristic of *O. hoskingii* var. *tabulatus* (*cf.* Plate v, Fig. 1, and Figs 4, 6). The structures have no known counterpart in the modern representatives of the family, and their function in the fossil is not apparent. The axes of *O. hoskingii* var. *tabulatus* are rhizomatous, while those of *O. hoskingii* var. *hoskingii* are usually arborescent, and the development of the " tabulae " may be linked with the rhizomatous condition. The stem and stele of the variety *tabulatus* are larger, the cortex thicker, and the petioles smaller and less well developed than those of the variety *hoskingii*.

Acknowledgements

The author is indebted to Dr. G. Playford of the Department of Geology and Mineralogy, University of Queensland, for considerable assistance and advice. The work was undertaken at the University of Queensland with financial support of a Commonwealth Post-Graduate Award.

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EXPLANATION OF PLATES

Plate iii

Figs 1, 2. *Osmundacaulis hoskingii* sp. nov. var. *hoskingii* ; transverse sections. 1, UQF53535, from " Mt. Organ " Station ; ×1·6. 2, UQF53534, holotype, from " Mt. Organ " Station ; ×2·2. (Transmitted light.)

Plate iv

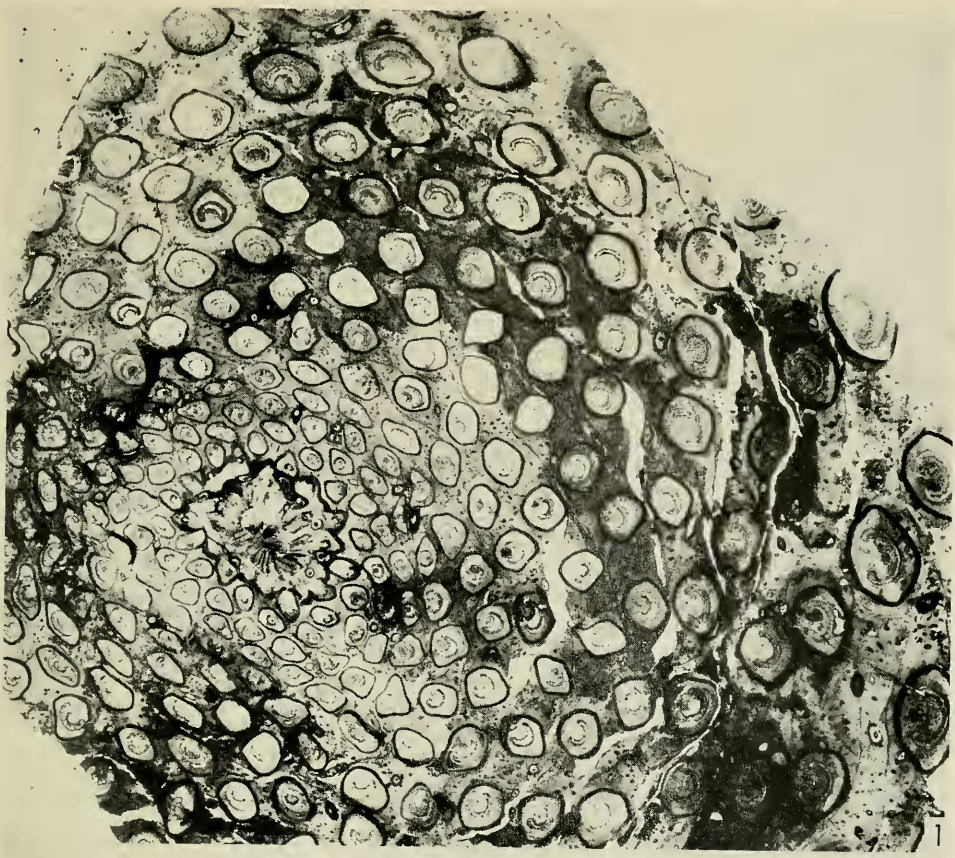
Figs 1–8. *Osmundacaulis hoskingii* sp. nov. var. *hoskingii*. 1, Transverse section of vascular trace of petiole close to stem, showing the incurved ends and the isolated circle of endodermis and sclerenchyma in the adaxial bay ; UQF53535 ; ×33. 2, Transverse section of petiole in mantle, showing crenate mass of sclerenchyma lining adaxial bay of vascular strand ; UQF53534, holotype ; ×9. 3, Transverse section of stem and inner layers of petiole bases ; pith intruded by foreign axes ; UQF59498, from " Mt. Organ " Station ; ×4. 4, Transverse section of petiole bases ; UQF53535 ; ×3·5. 5–8, UQF59498 ; transverse sections of xylem ring showing departure of leaf trace ; cortex of foreign axis in lower right of Fig. 6 ; the occurrence of three, instead of two, adaxial protoxylem groups on the departing leaf trace in Fig. 8 is atypical ; Fig. 5, ×22 ; Figs 6–8, ×20. (Figs 1–3, 5–8, transmitted light ; Fig. 4, transmitted and reflected light.)

Plate v

All Figures ×2

Fig. 1. *Osmundacaulis hoskingii* sp. nov. var. *hoskingii*. Longitudinal section of stem and adhering petiole bases ; UQF53535.

Figs 2–6. *Osmundacaulis hoskingii* sp. nov. var. *tabulatus* var. nov. 2–4, Varietal type, UQF53539, from " Mt. Organ " Station. 2, 3, Transverse sections ; the section in Fig. 3 contains a root in the pith. 4, Longitudinal section showing the tabulate structures in the pith ; note root in cross-section within pith at lower left. 5, 6, UQF53540, from " Mt. Organ " Station. 5, Transverse section showing external mantle of roots. 6, Longitudinal section ; note tabulae-like structures in the pith.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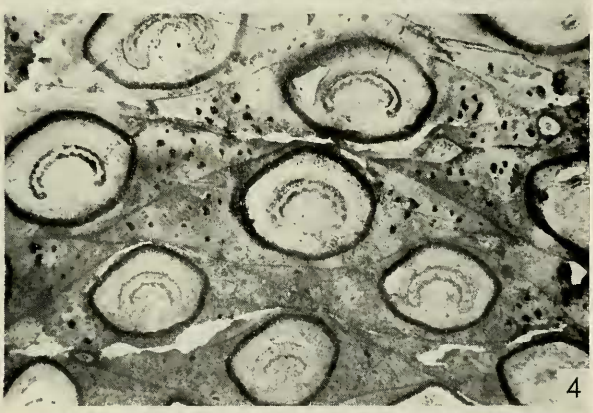
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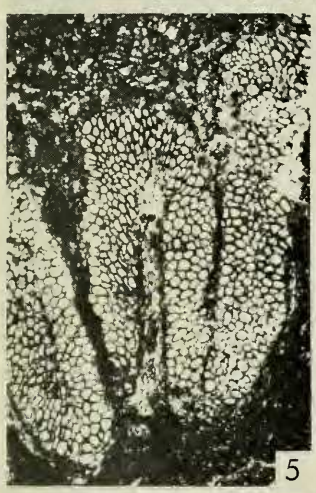
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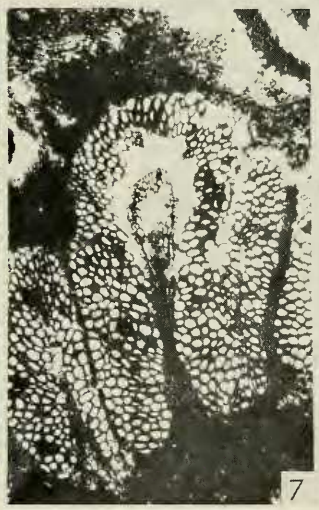
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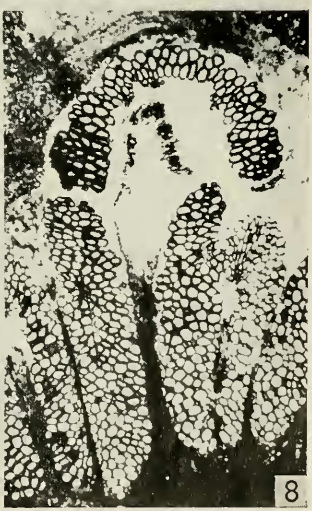
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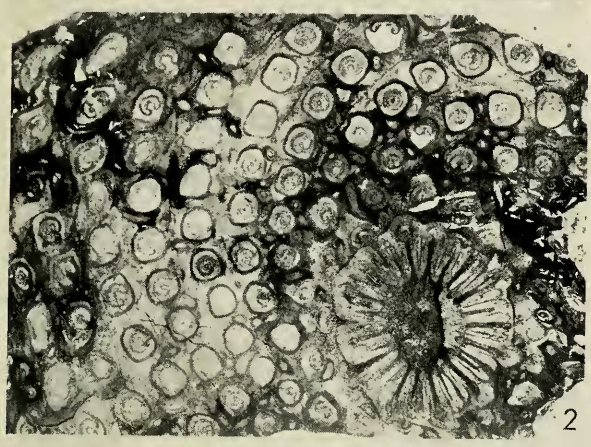
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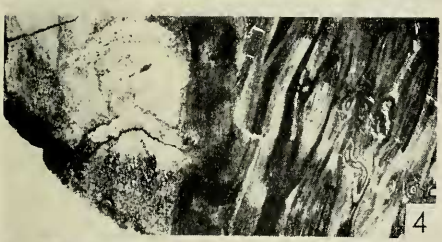
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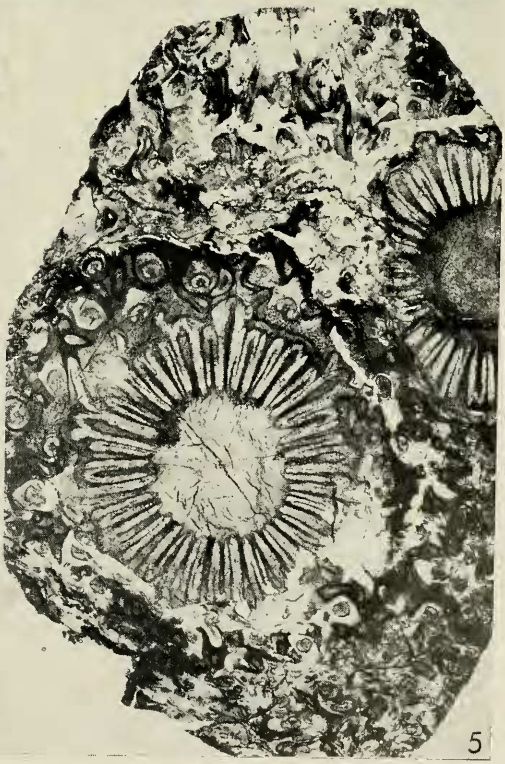
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